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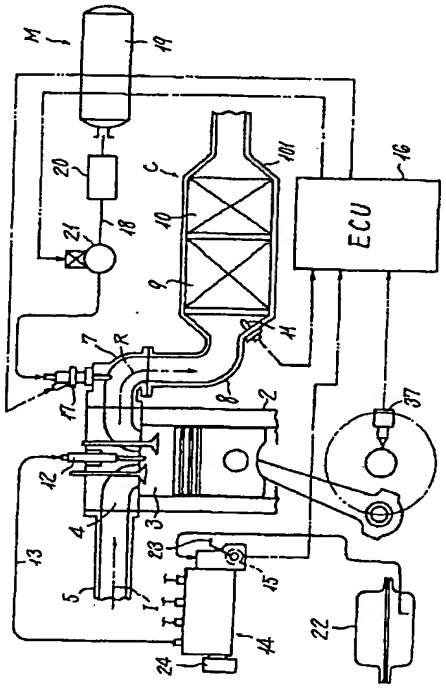
(54)【発明の名称】　排気ガス浄化装置

(57)【要約】

【目的】　この発明の目的は、ＮＯｘ触媒の雰囲気温度が比較的低温域にあっても、添加量の割にＮＯｘ浄化効率を高めることにある。

【構成】　排気路Ｒ上に設けられ炭化水素を還元剤として活性化され窒素酸化物ＮＯｘを分解する窒素酸化物還元触媒９と、排気路Ｒ上で上記窒素酸化物還元触媒の上流側に設けられる還元用炭化水素添加手段Ｍとを有し、還元用炭化水素添加手段Ｍは燃料を改質しタンク１９，３３，３９に貯蔵した炭化水素を主成分とした還元用炭化水素を排気路Ｒに添加することを特徴とする。



【特許請求の範囲】

【請求項１】ディーゼルエンジンの排気を外部に排出する排気路上に設けられ炭化水素を還元剤として窒素酸化物を分解する窒素酸化物還元触媒と、上記排気路上で上記窒素酸化物還元触媒の上流側に設けられる還元用炭化水素添加手段とを有し、上記還元用炭化水素添加手段は燃料を改質しタンクに貯蔵した炭化水素を主成分とした還元用炭化水素を上記排気路に添加することを特徴とする排気ガス浄化装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、たとえば、車両のディーゼルエンジンから排出される排気ガスからＮＯｘ（窒素酸化物）を効率良く排除できる排気ガス浄化装置、特にここでは窒素酸化物還元触媒に還元用炭化水素を添加してその浄化効率を向上させる排気ガス浄化装置に関する。

【０００２】

【従来の技術】一般に、車両のエンジンを駆動することにより排出される排気ガス中にはCO_2，H_2O，N_2の他に、ＣＯ（一酸化炭素），ＨＣ（炭化水素），ＮＯｘ（窒素酸化物）が含まれる。ここでＣＯ（一酸化炭素），ＨＣ（炭化水素），ＮＯｘ（窒素酸化物）は有害成分としてその排出量が規制されており、通常、ガソリンエンジンではその排気系に三元触媒が装着され、しかも、空燃比が理論空燃比に調整されることによって、これらの有害成分の無害化処理を行なっている。

【０００３】これに対して、ディーゼルエンジンは酸素過剰下で運転されることより、空燃比を理論空燃比に合わせることができず、三元触媒を用いての排ガス浄化処理は行なえなかった。即ち、供給酸素量が多い状態で運転されるディーゼルエンジンではＣＯ，ＨＣの排出量は比較的少なく、これに対して、ＮＯｘの排出量が高レベルと成る。

【０００４】このため、ディーゼルエンジンの排気系にはリーン運転下でＮＯｘを還元処理できる窒素酸化物還元触媒を内蔵したＮＯｘ触媒コンバータが装着される傾向にあり、各種提案が成されている。

【０００５】処で、ディーゼルエンジンの排気系にＮＯｘを還元処理できるＮＯｘ触媒が装着された場合、そのＮＯｘ触媒は図８に示すような活性化温度Ｔｓｏを上回るとその浄化効率を高め、しかも排気ガス中のＨＣ（炭化水素）／ＮＯｘのモル比が所定量を上回るとその浄化効率を向上させることが知られており、たとえば図９に示すような触媒活性域Ａを有している。なお、ここで横軸はＨＣ／ＮＯｘの体積比であるモル比で表され、縦軸は排気ガスの温度で、ここでの一例としてのＮＯｘ触媒の触媒活性域はＨＣ／ＮＯｘモル比が１以上ある場合と成っている。

【０００６】これ故にＮＯｘ触媒の浄化効率η_{NOX}を高めるべく、排気系のＮＯｘ触媒の上流側に還元用炭化水素ＨＣを添加することが有効であると推測される。しかし、排気系への添加の場合、燃料である軽油を添加すると、この軽油はＮＯｘ触媒の浄化効率を高めることはできるが、ディーゼルエンジンの出力には全く寄与せず、燃費の低下を招く可能性がある。

【０００７】なお、還元用炭化水素ＨＣ（炭化水素）を吸気路側に添加する方式を採ったものもあるが、吸気路に添加された還元用炭化水素ＨＣは、実質的にＮＯｘ触媒にどの程度達するか把握しずらく、しかも、添加されたＨＣ（炭化水素）はシリンダ内壁面近傍に達してピストンの隙間からのオイル中に混入し、オイルの劣化を早めるという問題も生じる。

【０００８】処で、軽油等の燃料を成すＨＣ（炭化水素）はその雰囲気、即ち温度や圧力によってその状態を変化させ、特に、炭素数の相違に応じた各成分毎にその特性は変化する。例えば、軽油はこれが常温常圧の雰囲気下にあると、その生成物の内、炭素数が５乃至１５にあるＨＣ（炭化水素）成分が液状を、炭素数４以下のＨＣ（炭化水素）成分がガス状を、炭素数１６以上のＨＣ（炭化水素）成分が固体状を成すが、これら状態は温度や圧力等の雰囲気の変化によって大きく変化する。しかも、各生成物毎にその特性、特に、ＮＯｘ触媒を活性化して窒素酸化物を分解する還元剤としての特性を異ならせていることが推定されている。

【０００９】

【発明が解決しようとする課題】このように、排気系に還元用炭化水素ＨＣとしての軽油等のＨＣ（炭化水素）を添加する場合は添加量を確実に把握でき、オイル劣化等の問題も生じないという利点があった。

【００１０】しかし、排気系にＨＣ（炭化水素）として軽油等の燃料を供給することによって、ＮＯｘ触媒を活性化出来るとしても、軽油等の燃料を改質して添加する場合、ガス、液体と個別にタンクに充分に貯蔵するようにしておかないと、常に変化するエンジン状態に最適な量を供給することは困難な場合が多い。即ち、タンク無しに、エンジン運転状態に応じたコントロールによってエンジンの燃料を改質処理し供給するとしても、ＮＯｘ触媒の浄化効率を充分に高めるだけの量の改質還元用炭化水素ＨＣを添加出来ることは限らず、量確保が困難な場合が多い。

【００１１】このように還元用炭化水素ＨＣとしての軽油等のＨＣ（炭化水素）を必要量だけ常に確保できるとは限らず、従来は、添加量不足や、逆に過剰供給によりＨＣ（炭化水素）の大気排出量が多くなるという問題があった。

【００１２】本発明の目的は、運転状態にかかわらず、常に、還元用炭化水素ＨＣを適量づつ添加して、ＮＯｘ浄化効率を高めることのできる排気ガス浄化装置を提供することにある。

【００１３】

【課題を解決するための手段】上述の目的を達成するために、本発明は、ディーゼルエンジンの排気を外部に排出する排気路上に設けられ炭化水素を還元剤として窒素酸化物を分解する窒素酸化物還元触媒と、上記排気路上で上記窒素酸化物還元触媒の上流側に設けられる還元用炭化水素添加手段とを有し、上記還元用炭化水素添加手段は燃料を改質しタンクに貯蔵した炭化水素を主成分とした還元用炭化水素を上記排気路に添加することを特徴とする。

【００１４】

【作用】燃料を改質してタンクに貯蔵した炭化水素を主成分とした還元用炭化水素が排気路に添加されるので、運転状態に応じた必要添加量を確保出来ることと成る。

【００１５】

【実施例】図１の排気ガス処理装置はディーゼルエンジン（以後単にエンジンと記す）１に装着されている。このエンジン１のエンジンブロック２内には４つの燃焼室３（図１には一気筒のみを示した）が直列に配設され、各燃焼室３の吸気ポート４は吸気マニホールド５に連通し、同吸気マニホールド５に図示しない吸気管やエアクリーナが連結され、他方、各燃焼室３の排気ポート６は排気マニホールド７に連通し、同排気マニホールド７に排気管８を介して窒素酸化物還元触媒（以後単にＮＯｘ触媒と記す）９及び酸化触媒１０を収容した触媒コンバータＣや図示しないマフラー等が順次連結され、排気路Ｒが構成されている。

【００１６】各燃焼室３は燃料噴射弁１２をそれぞれ備え、各燃料噴射弁１２は各燃料パイプ１３を介して燃料噴射ポンプ１４に連結されている。この燃料噴射ポンプ１４はエンジン１の図示しないクランクシャフトの回転力を受けて駆動される列型ポンプであり、燃料タンク２２より燃料（軽油）供給を受け、図示しないアクセルペダルに連動するロードレバー２３のレバー位置V_Lに応じて燃料噴射量を調量し、タイマー２４により調整される噴射時期に各燃料噴射弁１２を駆動させるという周知の構成を採る。即ち、燃料噴射ポンプ１４は各気筒の圧縮上死点前の噴射時期において各気筒に対応する各燃料噴射弁１２を噴射駆動させ、高圧燃料（軽油）を各気筒の燃焼室に噴霧するように構成されている。図１中において符号１５は燃料噴射弁１４のレバー位置V_L信号、即ち、負荷情報を後述のＥＣＵ１６に伝える負荷センサを示す。

【００１７】触媒コンバータＣはそのケーシング１０１内にモノリス型の触媒担持体を直列状に一対備え、各触媒担持体にはゼオライト系のＮＯｘ触媒９と、パラジュームＰｄ系や、Ｐｔ系などの酸化触媒１０とを装備する。図１中の符号１１はケーシング１０１に支持され、排気ガス温度Ｔ情報を後述のＥＣＵ１６に出力する排温センサを示す。

【００１８】ここでゼオライト系のＮＯｘ触媒９としては、例えば、銅系ゼオライト触媒（ＣＵ／ＺＳＭ－５）が採用される。この触媒の特性は、ＨＣの供給を受けることにより、このＨＣ成分を還元剤としてより浄化効率を向上させ、ＮＯｘを効果的にN_2とO_2に分解する。他方、パラジュームＰｄ系の酸化触媒１０はＨＣ（炭化水素）等を効果的にH_2O，CO_2に分解する能力を有する。

【００１９】更に、排気マニホールド７の合流部近傍には改質した炭化水素を主成分とした還元用炭化水素を排気路Ｒに添加する還元用炭化水素添加手段Ｍが連結されている。この還元用炭化水素添加手段ＭはＨＣインジェクタ１７と、ＨＣインジェクタ１７にＨＣパイプ１８を介して順次連結される開閉弁２１、レギュレータ２０及び軽油等の燃料を改質して得た改質ガスとしてのエチレンC_2H_4を充填したＨＣタンク１９とで構成されている。

【００２０】ここで、ＨＣインジェクタ１７は流体噴射装置であり、例えば、図２に示すように排気マニホールド７に支持される本体２５と、本体２５内の先端に形成される噴射孔２６と、噴射孔２６を開閉させる弁体２７と、弁体を閉弁付勢するバネ２８と、バネの弾性力に抗して弁体２７を開弁方向に駆動するソレノイド２９と、噴射孔２６にＨＣパイプ１８からのエチレンC_2H_4を導くガイド部３０とで構成されている。ここでソレノイド２９は後述のＥＣＵ１６に接続され、同部のオンオフ信号（デューティー比）に応じて弁体２７が噴射孔２６を開閉駆動させ、そのデューティー比がゼロでは無噴射を、デューティー比が１００％では最大噴射量を確保することができる。

【００２１】開閉弁２１は後述のＥＣＵ１６からのオンオフ信号によって切り換えられ、適時にエチレンC_2H_4をＨＣインジェクタ１７に供給する。レギュレータ２０はＨＣタンク１９からのガスであるエチレンC_2H_4の圧力を所望値に減圧して開閉弁２１に供給する。ＨＣタンク１９は予め軽油等の燃料の改質処理によって得られたエチレンC_2H_4を充填した高圧タンクであり、予め個別にタンクに貯蔵して工場生産され、適時に交換して車載される。なお、このＨＣタンク１９に燃料を改質した改質ガスに代えて、燃料を改質した改質液体である炭化水素を主成分とした還元用炭化水素を貯蔵し、供給するようにしても良い。

【００２２】ＥＣＵ１６は周知のマイクロコンピュータで要部が構成され、ここではクランク角情報である各気筒毎の噴射時期θi情報をクランク角センサ３７より取り込み、燃料噴射弁１４のレバー位置V_L情報を負荷センサ１５より取り込み、排気ガス温度Ｔ情報を排温センサ１１より取り込み、図４乃至図５のプログラムに沿ってＨＣインジェクタ１７を駆動するように機能する。

【００２３】以下、図４乃至図５のプログラムに沿って

本装置の作動を説明する。

【００２４】エンジン１が運転に入ると、ＥＣＵ１６は図示しない周知のメインルーチンに沿ってエンジン駆動制御に入る。

【００２５】メインルーチンではエンジン始動と共に開閉弁２１をオン作動し、両タンク３３，３９の貯蔵量が所定値を上回るか否か判断し下回るとタンク交換指令を発っし、その途中でＨＣ噴射制御ルーチンに達すると、図４の制御に進む。

【００２６】ここでステップｓ１、ｓ２では排気ガス温度Ｔｇを取り込み、同排気ガス温度Ｔｇが予め設定されている触媒活性化温度Ｔｓｏを上回る前は暖機中と見做してステップｓ３に進み、デューティー比ＤＵｓをゼロ、即ち無噴射として処理し、メインルーチンにリターンする。逆に、ステップｓ２で排気ガス温度Ｔｇが触媒活性化温度Ｔｓｏを上回り、触媒が活性化したと見做されると、ステップｓ４に達し、予めメインルーチンで算出されているレバー位置V_L及びエンジン回転数Ｎｅ情報を取り込む。その後、ステップｓ５では図３のＨＣ噴射量相当デューティー比算出マップに基づき、ＨＣ噴射量相当デューティー比ＤＵｓを算出し、メインルーチンにリターンする。

【００２７】このステップｓ５で用いるＨＣ噴射量相当デューティー比算出マップは、レバー位置V_L及びエンジン回転数Ｎｅに応じたエチレンＣ２Ｈ４の目標量（全筒相当分）相当のＨＣ噴射量相当デューティー比ＤＵｓを算出することができるように予め設定される。

【００２８】他方、メインルーチンでは、クランク角センサ３６よりの噴射時期θiパルスによる割り込み処理が実行されており、ここでは、所定クランク角毎の噴射時期θiに達すると、図５に示すステップｍ１において最新のＨＣ噴射量相当デューティー比ＤＵｓを取り込む。更にステップｍ２では同デューティー比ＤＵｓでＨＣインジェクタ１７を駆動し、排気路Ｒ下流に全筒相当量のエチレンC_2H_4を添加し、メインルーチンにリターンする。

【００２９】このように、この装置ではエンジン１のＮＯｘ触媒９が活性化温度Ｔｓｏを上回った後の運転時において、エンジン負荷及びエンジン回転数が大きいほど多量のエチレンC_2H_4ガスを還元剤として排気路ＲよりＮＯｘ触媒に添加する。このためＮＯｘをN_2とO_2に確実に分解でき、同時にＨＣをH_2O，CO_2に分解し、しかも、ＮＯｘ触媒９を通過したＨＣを酸化触媒１０が確実にH_2O，CO_2に分解するので、ＨＣをそのまま大気放出することを確実に防止できる。

【００３０】ここで、図７に還元用炭化水素ＨＣとしてエチレンC_2H_4を用いた際のＮＯｘ触媒９のＮＯｘ、ＨＣ、ＣＯの排気ガス温度に応じた各浄化効率ηを示した。なお、図６には還元用炭化水素ＨＣとして軽油を用い、他は同一条件で得られたＮＯｘ、ＨＣ、ＣＯの排気ガス温度に応じた各浄化効率ηを示した。

【００３１】これらより明らかなように、還元用炭化水素ＨＣとしてエチレンC_2H_4をＮＯｘ触媒に添加した場合の浄化効率（図７中の排気ガス温度３００℃の点での浄化効率η_G）のほうが、軽油添加の場合の浄化効率（図６中の排気ガス温度３００℃の点での浄化効率η_L）より明確に高められており、特に、ＮＯｘ触媒の排気ガス温度が比較的低温域にあっても、高効率でＮＯｘを浄化処理できる。この結果、エチレンC_2H_4添加によって、この添加量の割に、高効率でＮＯｘを浄化処理でき、無駄なＨＣ（炭化水素）の添加を防止し、燃費の低下を低減できるる。

【００３２】上述の処において、ガス化したＨＣ（炭化水素）としてエチレンC_2H_4を説明したが、これに代えて、プロピレンC_3H_6その他のガス化したＨＣ（炭化水素）を用いることもできる。

【００３３】上述の処において、還元用炭化水素添加手段ＭはエチレンC_2H_4を排気路Ｒに添加していたが、これに代えて、図８に示すように還元用炭化水素添加手段Ｍ１が燃料タンク２２の軽油を軽油改質触媒３１で改質して改質ガス及び改質液体を生成し、これらをエンジン運転状態に応じ、排気路Ｒに添加しても良い。なお、軽油を改質した改質液体を還元用炭化水素として排気路Ｒに添加するとより効果的にＮＯｘを浄化出来る場合がある。

【００３４】この場合の還元用炭化水素添加手段Ｍ１は、軽油の燃料タンク２２に軽油改質手段３４、気液分離器３５を順次接続し、気液分離器３５の改質ガスを逆流防止弁３２を介し改質燃料タンク３３に、改質液体を改質燃料液体タンク３９及び余剰分を燃料タンク２２に戻すように接続される。ここで、改質燃料タンク３３及び改質燃料液体タンク３９が図示しない切換え弁を介しＨＣインジェクタ１７に接続される。ここで、図示しない切換え弁及びＨＣインジェクタ１７はＥＣＵ１６により駆動制御される。

【００３５】軽油改質手段３４はヒータ３６を備えた改質触媒収容器３７に軽油改質触媒３１を充填する。ヒータ３６はヒータ駆動回路３８を介してＥＣＵ１６に連結されている。軽油改質触媒３１としてはゼオライト系の軽油改質触媒が採用される。

【００３６】このゼオライト系の軽油改質触媒は供給された軽油をガス状及び液状のＨＣ（炭化水素）成分、即ち、還元用炭化水素ＨＣに変化させる。ここで、軽油改質手段３４からの生成物は気液分離器３５で比較的低分子の改質ガスであるＨＣ（炭化水素）成分とその他の改質液体であるＨＣ（炭化水素）成分に分離され、改質ガスが改質燃料タンク３３に、その他の改質液体が改質燃料液体タンク３９に、その余剰分が燃料タンク２２にそれぞれ戻される様に構成される。

【００３７】なお、軽油改質触媒３１はヒータ３６によ

る加熱処理を受けて、軽油の成分比率を低分子成分比率の高い生成物（ガス状生成物）に改質するというハイドロクラッキング作用を示すものであり、このような軽油改質触媒として使用できるゼオライト系の軽油改質触媒のハイドロクラッキング作用については特公昭５１－１５０００号公報に開示されている。

【００３８】この場合、ＥＣＵ１６は図示しないメインルーチンにおいて両タンク３３，３９の貯蔵量が所定値を上回るまで改質ガス及び改質液体を継続的に生成する処理を行ない、所定量上回ると改質処理を停止するという制御を繰り返す。そして、エンジン負荷及びエンジン回転数が大きいほど多量の改質ガスあるいは改質液体を車載のタンク１７，３９よりＨＣインジェクタ１７に選択的に導き、ＮＯｘ触媒９に添加する制御を行ない、これによって、エンジンの広範囲の運転域でＮＯｘ触媒の浄化効率η_{NOX}を十分に高められる。

【００３９】

【発明の効果】以上のように、本発明の排気ガス浄化装置は、排気路に予めタンクに貯蔵されている燃料を改質しタンクに貯蔵した炭化水素を主成分とした還元用炭化水素を添加するので、運転状態にかかわらず、常に、還元用炭化水素ＨＣを適量づつ添加して、ＮＯｘ浄化効率を高めることが出来る。

【図面の簡単な説明】

【図１】本発明の排気ガス浄化装置の概略全体構成図である。

【図２】図１の装置で用いるＨＣインジェクタの断面図である。

【図３】図１の装置で用いるＨＣ噴射量相当デューティ一比算出マップの特性線図である。

【図４】図１の装置で用いるＨＣ噴射制御ルーチンのフローチャートである。

【図５】図１の装置で用いるインジェクタ駆動ルーチンのフローチャートである。

【図６】軽油添加時の浄化効率の一例を示す特性線図である。

【図７】本装置にエチレンＣ２Ｈ４添加した際の浄化効率の一例を示す特性線図である。

【図８】本発明の他の実施例で用いる還元用炭化水素添加手段の概略構成線図である。

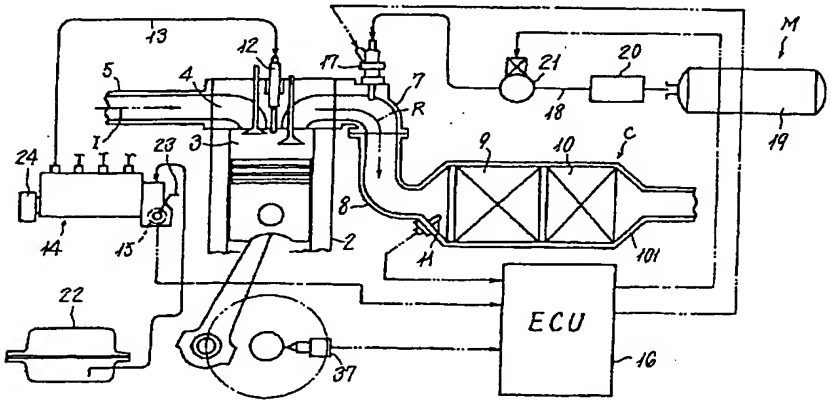
【図９】排気ガス浄化装置で用いるＮＯｘ触媒の浄化効率特性線図である。

【図１０】排気ガス浄化装置で用いるＮＯｘ触媒の触媒活性域特性線図である。

【符号の説明】

１	エンジン
３	燃焼室
８	排気管
９	ＮＯｘ触媒
１０	酸化触媒
１２	燃料噴射弁
１６	ＥＣＵ
１７	ＨＣインジェクタ
Ｃ	触媒コンバータ
Ｒ	排気路
Ｍ	還元用炭化水素添加手段
２１	燃料改質手段

【図１】



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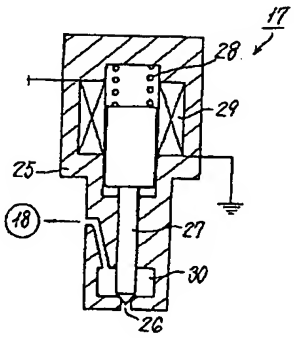
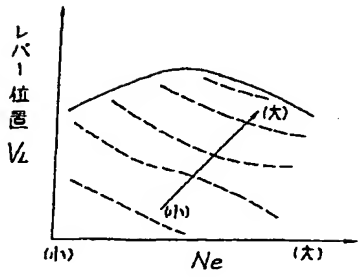


【図３】



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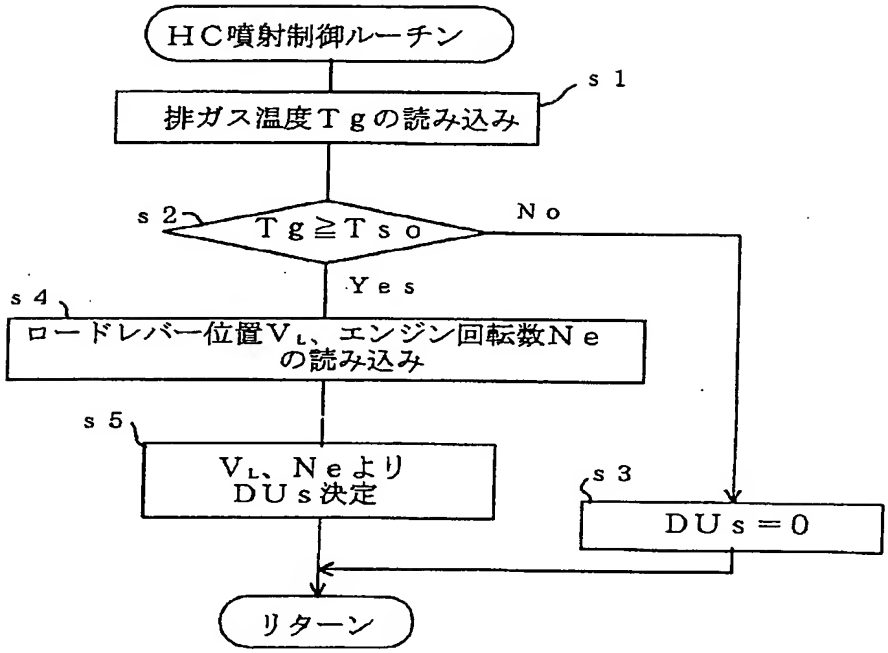

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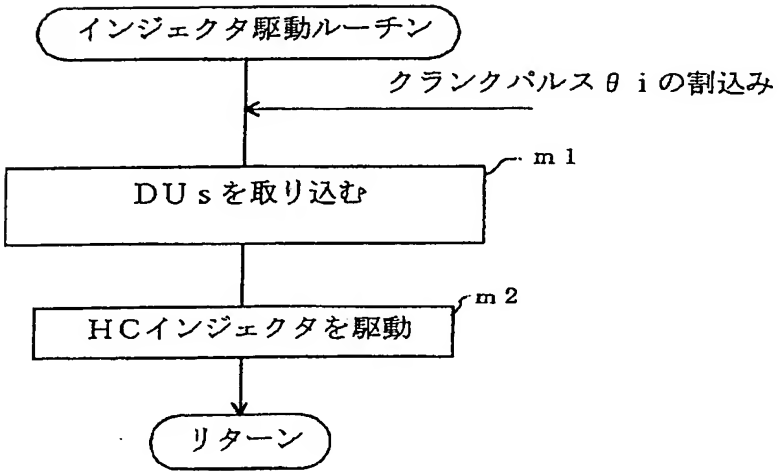

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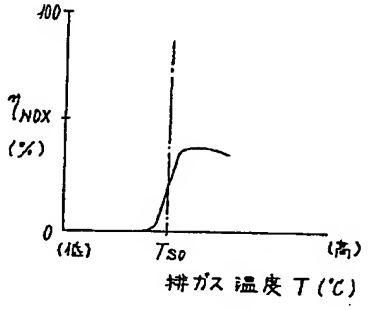

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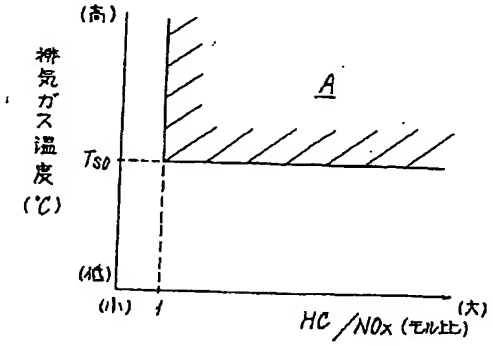
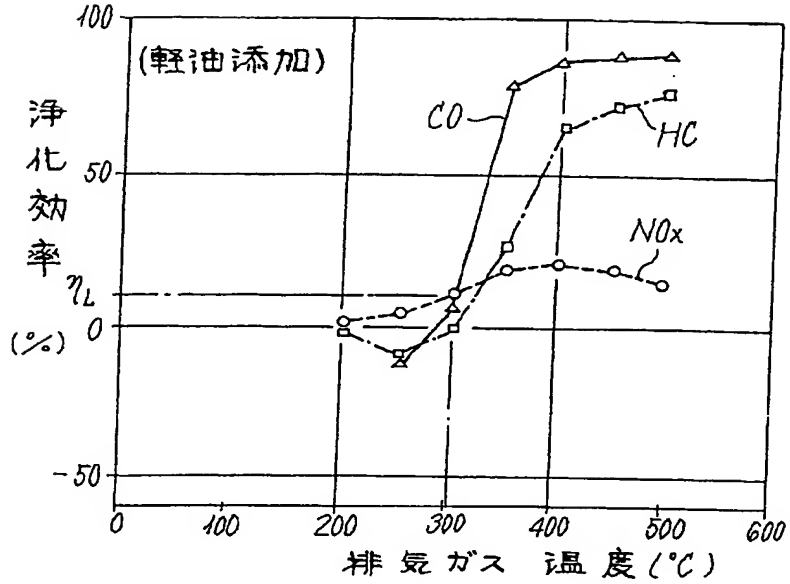
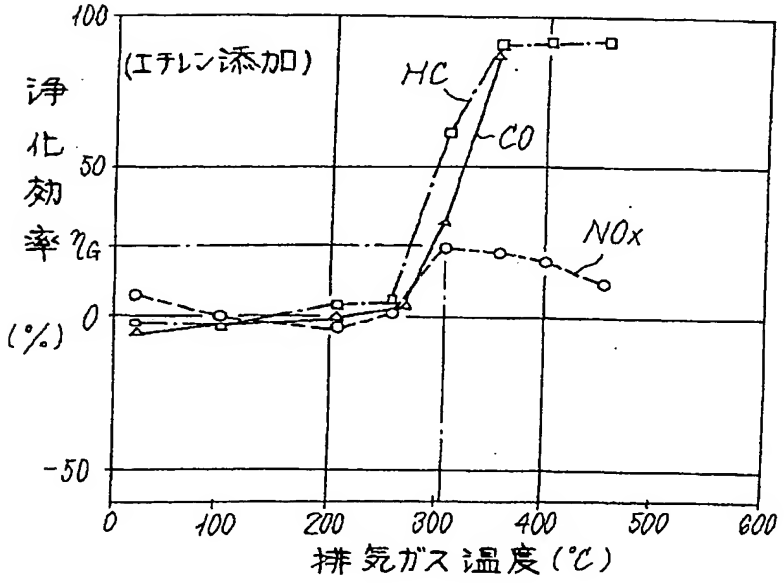


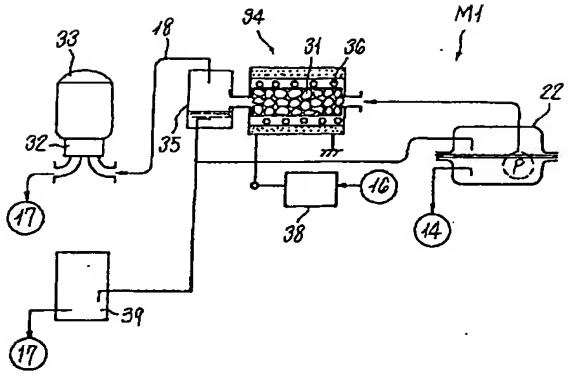
【図６】


100
(軽油添加)
CO
HC
NOx
浄化効率
50
η_L
0
(%)
-50
0
100
200
300
400
500
600
排気ガス　温度(℃)

【図７】


100
(エチレン添加)
HC
CO
NOx
浄化効率
50
η_G
0
(%)
-50
0
100
200
300
400
500
600
排気ガス温度(℃)

【図８】



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	3/28	３０１　Ｃ			

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(71)Applicant : MITSUBISHI MOTORS CORP

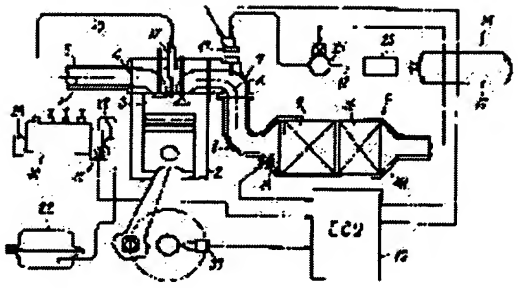
(72)Inventor : TAKAHASHI YOSHINORI
KISHI YOSHIAKI

(54) EXHAUST EMISSION CONTROL DEVICE

(57)Abstract:

PURPOSE: To heighten NOx purifying efficiency in proportion to an adding quantity even if an atmospheric temperature of NOx catalyst is in a comparatively low temperature area.

CONSTITUTION: An exhaust emission control device has nitrogen oxide reducing catalyst 9 arranged in an exhaust gas passage R so as to decompose activated nitrogen oxides NOx by using hydrocarbon as a reducing agent and a reducing hydrocarbon adding means M arranged on the upstream side of the nitrogen oxide reducing catalyst 9 in the exhaust gas passage R, and the reducing hydrocarbon adding means M reforms fuel, and adds reducing hydrocarbon mainly composed of hydrocarbon stored in a tank 19 or the like to the exhaust gas passage R.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

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2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] It is exhaust-air gas-cleanup equipment carry out adding the hydrocarbon for reduction carried out the hydrocarbon which it has the nitrogen-oxide reduction catalyst which is prepared in in the road [exhaust-air] exhaust air of a diesel power plant is discharged outside, and decomposes nitrogen oxide by using a hydrocarbon as a reducing agent, and the hydrocarbon addition means for reduction which are prepared in the upstream of the above-mentioned nitrogen-oxide reduction catalyst by the above-mentioned exhaust-air on the street, and the above-mentioned hydrocarbon addition means for reduction reformed fuel, and stored to a tank as a principal component to the above-mentioned exhaust-air way as the feature.

[Translation done.]

* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the exhaust air gas cleanup equipment which can eliminate NOx (nitrogen oxide) efficiently from the exhaust gas discharged from the diesel power plant of vehicles, especially the exhaust air gas cleanup equipment which adds the hydrocarbon for reduction to a nitrogen oxide reduction catalyst here, and raises the purification efficiency.
[0002]
[Description of the Prior Art] In the exhaust gas generally discharged by driving the engine of vehicles, CO (carbon monoxide), HC (hydrocarbon), and NOx (nitrogen oxide) other than CO2, H2O, and N2 are contained. The discharge is regulated as an injurious ingredient, usually, by the gasoline engine, the exhaust air system is equipped with a three way component catalyst, and, moreover, CO (carbon monoxide), HC (hydrocarbon), and NOx (nitrogen oxide) are performing harmless-ized processing of these injurious ingredients by adjusting an air-fuel ratio to theoretical air fuel ratio here.
[0003] On the other hand, from a diesel power plant being operated under hyperoxia, an air-fuel ratio could not be doubled with theoretical air fuel ratio, and exhaust gas purification processing using a three way component catalyst was not able to be performed. That is, by the diesel power plant operated in the state with many amounts of supply oxygen, the discharge of NOx becomes that there are comparatively few discharges of CO and HC with a high level.
[0004] For this reason, it is in the inclination to be equipped with the NOx catalytic converter which contained the nitrogen oxide reduction catalyst which can carry out reduction processing of the NOx under RIN operation in the exhaust air system of a diesel power plant, and various proposals have accomplished.
[0005] When the exhaust air system of a diesel power plant is equipped with the NOx catalyst which can carry out reduction processing of the NOx in a place, it has the catalytic activity region A as the NOx catalyst raised the purification efficiency if it exceeds the activation temperature Tso as shown in drawing 8 , raising the purification efficiency known if the mole ratio of HC (hydrocarbon)/NOx in exhaust gas moreover exceeds the specified quantity, for example, shown in drawing 9 . In addition, a horizontal axis is expressed with the mole ratio which is a volume ratio of HC/NOx here, a vertical axis is the temperature of exhaust gas and, as for the catalytic activity region of the NOx catalyst as an example here, the HC/NOx mole ratio changes with a certain case one or more.
[0006] It is surmised that it is effective in the upstream of the NOx catalyst of an exhaust air system to add the hydrocarbon HC for reduction to raise purification efficiency etaNOX of this, therefore a NOx catalyst. However, if the gas oil which is fuel is added in the addition to an exhaust air system, although this gas oil can raise the purification efficiency of a NOx catalyst, it may not contribute to the output of a diesel power plant at all, but it may cause the fall of mpg.
[0007] In addition, although there are some which took the method which adds the hydrocarbon HC for reduction (hydrocarbon) to an inhalation-of-air road side, the problem of ****** and HC (hydrocarbon) moreover added reaching near the cylinder internal surface, mixing it into the oil from the crevice

between pistons, and bringing degradation of oil forward is also produced by grasping how much the hydrocarbon HC for reduction added by the inhalation-of-air way reaches a NOx catalyst substantially.
[0008] HC (hydrocarbon) which accomplishes fuel, such as gas oil, in a place changes the state with the atmosphere, i.e., temperature, and a pressure, and the property changes for each component of every according to the difference of a carbon number especially. For example, although four or less-carbon number HC (hydrocarbon) component constitutes the shape of gas and 16 or more-carbon number HC (hydrocarbon) component constitutes [HC (hydrocarbon) component which has a carbon number in 5 or 15 among the product when gas oil has this under the atmosphere of an ordinary temperature ordinary pressure] the shape of a solid-state, these states change the shape of liquid with change of atmosphere, such as temperature and a pressure, a lot. And changing the property and the property as a reducing agent which activates a NOx catalyst and decomposes nitrogen oxide especially for every product is presumed.
[0009]
[Problem(s) to be Solved by the Invention] Thus, when HC (hydrocarbon), such as gas oil as a hydrocarbon HC for reduction, is added in an exhaust air system, the addition has been grasped certainly, and there was an advantage of not producing problems, such as oil degradation,, either.
[0010] However, if it is not made not to fully store according to gas, a liquid, and an individual at a tank when reforming fuel, such as gas oil, and adding, though a NOx catalyst is activable by supplying fuel, such as gas oil, to an exhaust air system as HC (hydrocarbon), it is difficult to supply the optimal amount for the engine state of always changing in many cases. That is, it does not restrict that the hydrocarbon HC for reforming reduction of only the amount which fully raises the purification efficiency of a NOx catalyst can be added without a tank though reforming processing is carried out and the fuel of an engine is supplied with the control according to the engine operation state, but amount reservation is difficult for it in many cases.
[0011] Thus, it did not restrict that only an initial complement could always secure HC (hydrocarbon), such as gas oil as a hydrocarbon HC for reduction, but there were a shortage of an addition and a problem that the amount of atmospheric exhausts of HC (hydrocarbon) increased by overage conversely, conventionally.
[0012] Irrespective of operational status, always, the purpose of this invention adds the hydrocarbon HC for reduction optimum dose every, and is to offer the exhaust air gas cleanup equipment which can raise NOx purification efficiency.
[0013]
[Means for Solving the Problem] The nitrogen oxide reduction catalyst which this invention is prepared in in the road [exhaust air] exhaust air of a diesel power plant is discharged outside, uses a hydrocarbon as a reducing agent, and decomposes nitrogen oxide in order to attain the above-mentioned purpose, It is characterized by adding the hydrocarbon for reduction which made the principal component the hydrocarbon which it has the hydrocarbon addition means for reduction prepared in the upstream of the above-mentioned nitrogen oxide reduction catalyst by the above-mentioned exhaust air on the street, and the above-mentioned hydrocarbon addition means for reduction reformed fuel, and was stored in the tank on the above-mentioned exhaust air way.
[0014]
[Function] Since the hydrocarbon for reduction which made the principal component the hydrocarbon which reformed fuel and was stored in the tank is added by the exhaust air way, it changes with the required addition according to operational status being securable.
[0015]
[Example] The diesel power plant (it is only henceforth described as an engine) 1 is equipped with the exhaust air gas treatment equipment of drawing 1 . In the cylinder crank case 2 of this engine 1, four combustion chambers 3 (only a breath cylinder was shown in drawing 1) are arranged in series. The suction port 4 of each combustion chamber 3 is open for free passage to an inlet manifold 5, and the inlet pipe and air cleaner which are not illustrated to this inlet manifold 5 are connected. On the other hand, the exhaust air port 6 of each combustion chamber 3 is open for free passage to an exhaust

manifold 7, and catalytic-converter C which held the nitrogen oxide reduction catalyst (it is only henceforth described as a NOx catalyst) 9 and the oxidation catalyst 10 in this exhaust manifold 7 through the exhaust pipe 8, the muffler which is not illustrated are connected one by one. The exhaust air way R is constituted.

[0016] Each combustion chamber 3 is equipped with a fuel injection valve 12, respectively, and each fuel injection valve 12 is connected with the fuel injection pump 14 through each fuel pipe 13. This fuel injection pump 14 is a sequence-type pump driven in response to the turning effort of the crankshaft which an engine 1 does not illustrate, carries out metering of the fuel oil consumption according to the lever position VL of the load lever 23 interlocked with the accelerator pedal which does not receive and illustrate fuel (gas oil) supply from a fuel tank 22, and takes the composition of common knowledge of making each fuel injection valve 12 drive at fuel injection timing adjusted by the timer 24. That is, a fuel injection pump 14 carries out the injection drive of each fuel injection valve 12 corresponding to each cylinder in fuel injection timing in front of the compression top dead center of each cylinder, and it is constituted so that high-pressure fuel (gas oil) may be sprayed on the combustion chamber of each cylinder. A sign 15 shows the load sensor which tells below-mentioned ECU16, the lever position VL signal, i.e., the load information, on a fuel injection valve 14, in drawing 1 .

[0017] Catalytic-converter C equips a couple preparation and each catalyst support with the NOx catalyst 9 of a zeolite system, and the oxidation catalysts 10, such as a palladium Pd system and Pt system, for the catalyst support of a monolith type in the shape of a serial in the casing 101. The sign 11 in drawing 1 is supported by casing 101, and shows the emission temperature sensor which outputs exhaust gas temperature T information to below-mentioned ECU16.

[0018] As a NOx catalyst 9 of a zeolite system, a copper system zeolite catalyst (CU/ZSM -5) is adopted here, for example. By receiving supply of HC, as for the property of this catalyst, this HC component raises purification efficiency as a reducing agent, and it decomposes NOx into N2 and O2 effectively. On the other hand, the oxidation catalyst 10 of a palladium Pd system has the capacity which decomposes HC (hydrocarbon) etc. into H2O and CO2 effectively.

[0019] Furthermore, a hydrocarbon addition means M for reduction to add the hydrocarbon for reduction which made the principal component the hydrocarbon reformed near the unification section of an exhaust manifold 7 on the exhaust air way R is connected. This hydrocarbon addition means M for reduction consists of HC tanks 19 filled up with ethylene C2H4 as reformed gas which reformed and obtained fuel, such as the opening-and-closing valve 21 and regulator 20 which are connected with the HC injector 17 and the HC injector 17 one by one through the HC pipe 18, and gas oil.

[0020] The main part 25 supported by the exhaust manifold 7 as the HC injector 17 is a fluid fuel injection equipment, for example, it is shown in drawing 2 here, The nozzle 26 formed at the nose of cam in a main part 25, and the valve element 27 which makes a nozzle 26 open and close, It consists of a spring 28 which carries out valve-closing energization of the valve element, a solenoid 29 which resists the elastic force of a spring and drives a valve element 27 in the valve-opening direction, and the guide section 30 which leads ethylene C2H4 from the HC pipe 18 to a nozzle 26. A solenoid 29 is connected to below-mentioned ECU16 here, a valve element 27 carries out the opening-and-closing drive of the nozzle 26 according to the on-off signal (duty ratio) of the said division, in zero, it can secure no injecting and duty ratio can secure [the duty ratio] the maximum injection quantity at 100%.

[0021] The opening-and-closing valve 21 is switched by the on-off signal from below-mentioned ECU16, and supplies ethylene C2H4 to the HC injector 17 timely. A regulator 20 decompresses the pressure of ethylene C2H4 which are gas from the HC tank 19 to a request value, and supplies it to the opening-and-closing valve 21. It is the high pressure tank filled up with ethylene C2H4 beforehand obtained by reforming processing of fuel, such as gas oil, and beforehand, it stores in a tank individually and works production is carried out, and the HC tank 19 is exchanged for timely and mounted. In addition, it replaces with the reformed gas which reformed fuel on this HC tank 19, the hydrocarbon for reduction which made the principal component the hydrocarbon which is the reforming liquid which reformed fuel is stored, and you may make it supply.

[0022] An important section consists of well-known microcomputers, and ECU16 incorporates the fuel-

injection-timing thetai information for every cylinder which is crank angle information here from the crank angle sensor 37, incorporates the lever position VL information on a fuel injection valve 14 from the load sensor 15, incorporates exhaust gas temperature T information from the emission temperature sensor 11, and functions as driving the HC injector 17 in accordance with the program of drawing 4 or drawing 5 .

[0023] Hereafter, the operation of this equipment is explained in accordance with the program of drawing 4 or drawing 5 .

[0024] If an engine 1 goes into operation, ECU16 will start engine drive control along with the main routine of the common knowledge which is not illustrated.

[0025] In a main routine, the ON operation of the opening-and-closing valve 21 is carried out with engine starting, if it judges whether the quantity to be stored of both the tanks 33 and 39 exceeds a predetermined value and is less, tank exchange instructions are ****(ed), and if HC injection control routine is reached in the middle, it will progress to control of drawing 4 .

[0026] At Steps s1 and s2, exhaust gas temperature Tg is incorporated, before exceeding the catalytic activity-ized temperature Tso to which this exhaust gas temperature Tg is set beforehand, it is regarded as under warming up, and progresses to Step s3, duty ratio DUs is processed as zero, i.e., injecting [no], and a return is carried out to a main routine here. On the contrary, exhaust gas temperature Tg exceeds the catalytic activity-ized temperature Tso at Step s2, if it is considered that the catalyst was activated, Step s4 will be reached and the lever position VL currently beforehand computed by the main routine and engine-speed Ne information will be incorporated. Then, at Step s5, based on HC injection-quantity equivalent duty ratio calculation map of drawing 3 , HC injection-quantity equivalent duty ratio DUs is computed, and a return is carried out to a main routine.

[0027] HC injection-quantity equivalent duty ratio calculation map used at this step s5 is beforehand set up so that HC injection-quantity equivalent duty ratio DUs equivalent to the lever position VL and the amount of targets of ethylene C2H4 according to the engine speed Ne (an equivalent for all cylinders) can be computed.

[0028] On the other hand, in a main routine, interruption processing by the fuel-injection-timing thetai pulse from the crank angle sensor 36 is performed, and if fuel-injection-timing thetai for every predetermined crank angle is reached, the newest HC injection-quantity equivalent duty ratio DUs in Step m1 shown in drawing 5 will be incorporated here. Furthermore, at Step m2, the HC injector 17 is driven by this duty ratio DUs, ethylene C2H4 of all cylinder considerable amounts are added on an exhaust air way R lower stream of a river, and a return is carried out to a main routine.

[0029] Thus, with this equipment, it adds for a NOx catalyst from the exhaust air way R by using such a lot of ethylene C2H4 gas that an engine load and an engine speed being large at the time of operation after the NOx catalyst 9 of an engine 1 exceeds an activation temperature Tso as a reducing agent. For this reason, since NOx can be certainly decomposed into N2 and O2, HC is simultaneously decomposed into H2O and CO2 and an oxidation catalyst 10 moreover decomposes into H2O and CO2 certainly HC which passed the NOx catalyst 9, it can prevent certainly carrying out air discharge of the HC as it is.

[0030] Here, each purification efficiency eta according to the exhaust gas temperature of NOx, HC, and CO of the NOx catalyst 9 at the time of using ethylene C2H4 for drawing 7 as a hydrocarbon HC for reduction was shown. In addition, others showed each purification efficiency eta according to the exhaust gas temperature of NOx, HC, and CO which were obtained on the same conditions to drawing 6 , using gas oil as a hydrocarbon HC for reduction.

[0031] The way of the purification efficiency (purification efficiency etaG in a point with an exhaust gas temperature [in drawing 7] of 300 degrees C) at the time of adding ethylene C2H4 for a NOx catalyst as a hydrocarbon HC for reduction so that more clearly than these Even if it is raised more clearly than the purification efficiency in gas oil addition (purification efficiency etaL in a point with an exhaust gas temperature [in drawing 6] of 300 degrees C) and the exhaust gas temperature of a NOx catalyst is in a low-temperature region comparatively especially, it is efficient and the purification processing of the NOx can be carried out. Consequently, ** which this addition is efficient comparatively, and the purification processing of the NOx can be carried out, prevents addition of useless HC (hydrocarbon),

and can reduce the fall of mpg by ethylene C2H4 addition.
[0032] In an above-mentioned place, although ethylene C2H4 were explained as gasified HC (hydrocarbon), it can replace with this and HC (hydrocarbon) which propylene C3H6 and others gasified can also be used.
[0033] In an above-mentioned place, although it had added ethylene C2H4 on the exhaust air way R, the hydrocarbon addition means M for reduction is replaced with this, as shown in drawing 8 , the hydrocarbon addition means M1 for reduction may reform the gas oil of a fuel tank 22 with the gas oil reforming catalyst 31, and may generate reformed gas and a reforming liquid, and may add these on the exhaust air way R according to an engine operation state. In addition, if it adds on the exhaust air way R by using as the hydrocarbon for reduction the reforming liquid which reformed gas oil, NOX may be able to be purified more effectively.
[0034] The hydrocarbon addition means M1 for reduction in this case connects the gas oil reforming means 34 and the vapor-liquid eliminator 35 to the fuel tank 22 of gas oil one by one, and the reformed gas of the vapor-liquid eliminator 35 is connected so that may be returned a reforming liquid to the reforming fuel tank 33 and a part for the reforming fuel liquid tank 39 and a surplus may be returned to a fuel tank 22 through a check valve 32. Here, it connects with the HC injector 17 through the change-over valve which the reforming fuel tank 33 and the reforming fuel liquid tank 39 do not illustrate. Here, drive control of the change-over valve and the HC injector 17 which are not illustrated is carried out by ECU16.
[0035] The gas oil reforming means 34 fills up the reforming catalyst hold machine 37 equipped with the heater 36 with the gas oil reforming catalyst 31. The heater 36 is connected with ECU16 through the heater drive circuit 38. As a gas oil reforming catalyst 31, the gas oil reforming catalyst of a zeolite system is adopted.
[0036] The gas oil reforming catalyst of this zeolite system changes the supplied gas oil to the shape of gas, and the liquefied HC (hydrocarbon) component HC, i.e., the hydrocarbon for reduction. The product from the gas oil reforming means 34 is divided into HC (hydrocarbon) component which is reformed gas comparatively low-molecular with the vapor-liquid eliminator 35, and HC (hydrocarbon) component which are other reforming liquids here, and reformed gas is constituted so that other reforming liquids may be returned to the reforming fuel liquid tank 39 and a part for the surplus may be returned to the reforming fuel tank 33 in a fuel tank 22, respectively.
[0037] In addition, the gas oil reforming catalyst 31 shows hydro cracking operation of reforming the component ratio of gas oil to a product with a high low-molecular component ratio (gas-like product), in response to the heat-treatment at a heater 36, and is indicated by JP,51-15000,B about the hydro cracking operation of the gas oil reforming catalyst of the zeolite system which can be used as such a gas oil reforming catalyst.
[0038] In this case, if ECU16 performs processing which generates reformed gas and a reforming liquid continuously and turns around it on the specified quantity until the quantity to be stored of both the tanks 33 and 39 exceeds a predetermined value in the main routine which is not illustrated, it will repeat control of suspending reforming processing. And from the tanks 17 and 39 of mount of so a lot of reformed gas or reforming liquids that be [large / an engine load and an engine speed], it leads to the HC injector 17 alternatively, control added for the NOx catalyst 9 is performed, and this fully raises purification efficiency etaNOX of a NOx catalyst in the wide range operation region of an engine.
[0039]
[Effect of the Invention] As mentioned above, since the exhaust air gas cleanup equipment of this invention adds the hydrocarbon for reduction which made the principal component the hydrocarbon which reformed the fuel beforehand stored in the exhaust air way by the tank, and was stored in the tank, irrespective of operational status, always, it can add the hydrocarbon HC for reduction optimum dose every, and can raise NOx purification efficiency.

[Translation done.]

* NOTICES *

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PRIOR ART

[Description of the Prior Art] In the exhaust gas generally discharged by driving the engine of vehicles, CO (carbon monoxide), HC (hydrocarbon), and NOx (nitrogen oxide) other than CO2, H2O, and N2 are contained. The discharge is regulated as an injurious ingredient, usually, by the gasoline engine, the exhaust air system is equipped with a three way component catalyst, and, moreover, CO (carbon monoxide), HC (hydrocarbon), and NOx (nitrogen oxide) are performing harmless-ized processing of these injurious ingredients by adjusting an air-fuel ratio to theoretical air fuel ratio here.
[0003] On the other hand, from a diesel power plant being operated under hyperoxia, an air-fuel ratio could not be doubled with theoretical air fuel ratio, and exhaust gas purification processing using a three way component catalyst was not able to be performed. That is, by the diesel power plant operated in the state with many amounts of supply oxygen, the discharge of NOx becomes that there are comparatively few discharges of CO and HC with a high level.
[0004] For this reason, it is in the inclination to be equipped with the NOx catalytic converter which contained the nitrogen oxide reduction catalyst which can carry out reduction processing of the NOx under RIN operation in the exhaust air system of a diesel power plant, and various proposals have accomplished.
[0005] When the exhaust air system of a diesel power plant is equipped with the NOx catalyst which can carry out reduction processing of the NOx in a place, it has the catalytic activity region A as the NOx catalyst raised the purification efficiency if it exceeds the activation temperature Tso as shown in drawing 8 , raising the purification efficiency known if the mole ratio of HC (hydrocarbon)/NOx in exhaust gas moreover exceeds the specified quantity, for example, shown in drawing 9 . In addition, a horizontal axis is expressed with the mole ratio which is a volume ratio of HC/NOx here, a vertical axis is the temperature of exhaust gas and, as for the catalytic activity region of the NOx catalyst as an example here, the HC/NOx mole ratio changes with a certain case one or more.
[0006] It is surmised that it is effective in the upstream of the NOx catalyst of an exhaust air system to add the hydrocarbon HC for reduction to raise purification efficiency etaNOX of this, therefore a NOx catalyst. However, if the gas oil which is fuel is added in the addition to an exhaust air system, although this gas oil can raise the purification efficiency of a NOx catalyst, it may not contribute to the output of a diesel power plant at all, but it may cause the fall of mpg.
[0007] In addition, although there are some which took the method which adds the hydrocarbon HC for reduction (hydrocarbon) to an inhalation-of-air road side, the problem of ****** and HC (hydrocarbon) moreover added reaching near the cylinder internal surface, mixing it into the oil from the crevice between pistons, and bringing degradation of oil forward is also produced by grasping how much the hydrocarbon HC for reduction added by the inhalation-of-air way reaches a NOx catalyst substantially.
[0008] HC (hydrocarbon) which accomplishes fuel, such as gas oil, in a place changes the state with the atmosphere, i.e., temperature, and a pressure, and the property changes for each component of every according to the difference of a carbon number especially. For example, although four or less-carbon number HC (hydrocarbon) component constitutes the shape of gas and 16 or more-carbon number HC (hydrocarbon) component constitutes [HC (hydrocarbon) component which has a carbon number in 5 or

15 among the product when gas oil has this under the atmosphere of an ordinary temperature ordinary pressure] the shape of a solid-state, these states change the shape of liquid with change of atmosphere, such as temperature and a pressure, a lot. And changing the property and the property as a reducing agent which activates a NOx catalyst and decomposes nitrogen oxide especially for every product is presumed.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the whole outline block diagram of the exhaust air gas cleanup equipment of this invention.
[Drawing 2] It is the cross section of HC injector used with the equipment of drawing 1 .
[Drawing 3] It is the ultimate-lines view of HC injection-quantity equivalent duty ratio calculation map used with the equipment of drawing 1 .
[Drawing 4] It is the flow chart of HC injection control routine used with the equipment of drawing 1 .
[Drawing 5] It is the flow chart of an injector drive routine used with the equipment of drawing 1 .
[Drawing 6] It is the ultimate-lines view showing an example of the purification efficiency at the time of gas oil addition.
[Drawing 7] It is the ultimate-lines view showing an example of the purification efficiency at the time of adding ethylene C2H4 at this equipment.
[Drawing 8] It is the outline composition diagram of the hydrocarbon addition means for reduction used in other examples of this invention.
[Drawing 9] It is the purification efficiency ultimate-lines view of a NOx catalyst used with exhaust air gas cleanup equipment.
[Drawing 10] It is the catalytic activity region ultimate-lines view of a NOx catalyst used with exhaust air gas cleanup equipment.
[Description of Notations]
1 Engine
3 Combustion Chamber
8 Exhaust Pipe
9 NOx Catalyst
10 Oxidation Catalyst
12 Fuel Injection Valve
16 ECU
17 HC Injector
C Catalytic converter
R Exhaust air way
M The hydrocarbon addition means for reduction
21 Fuel Reforming Means

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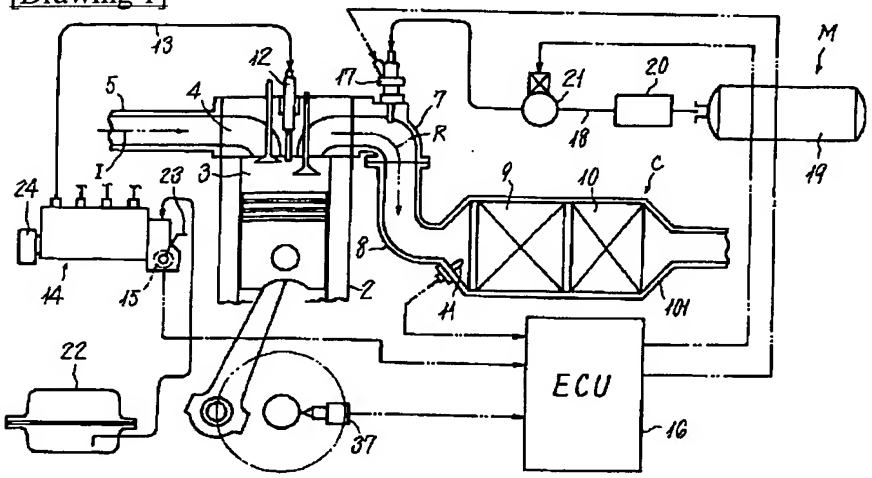
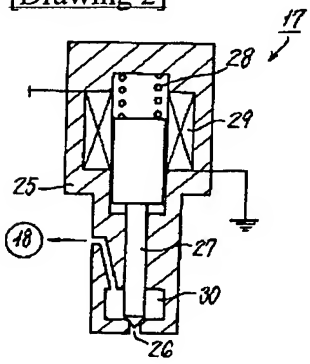
DRAWINGS

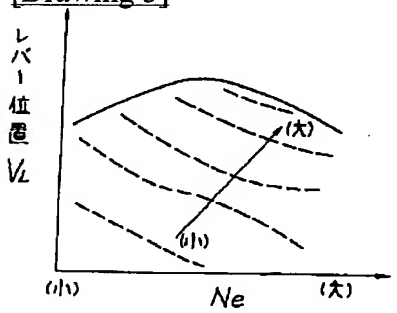
[Drawing 1]



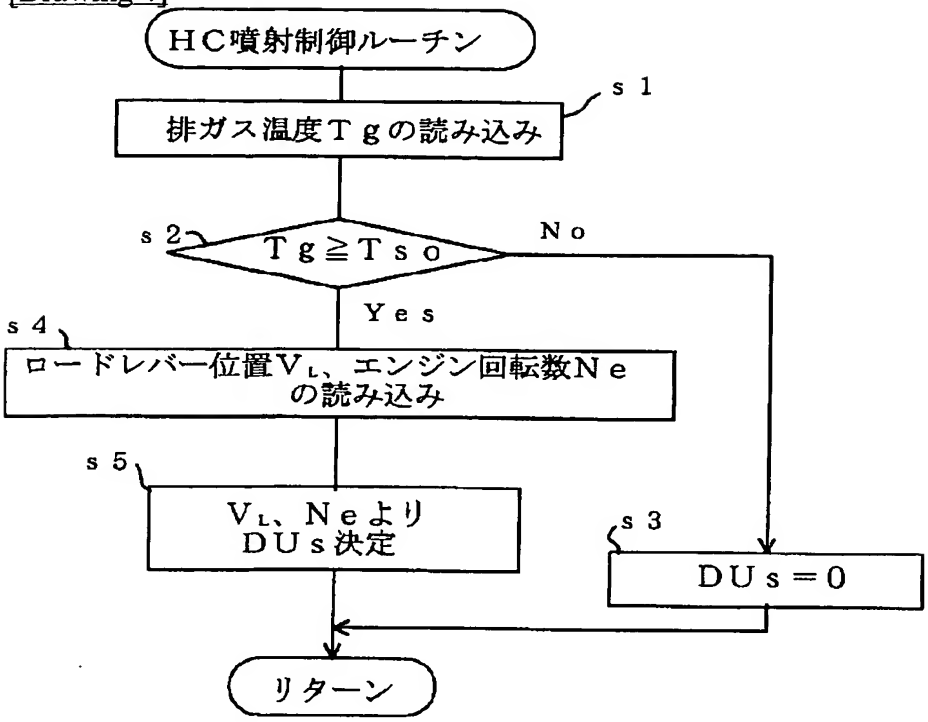
[Drawing 2]



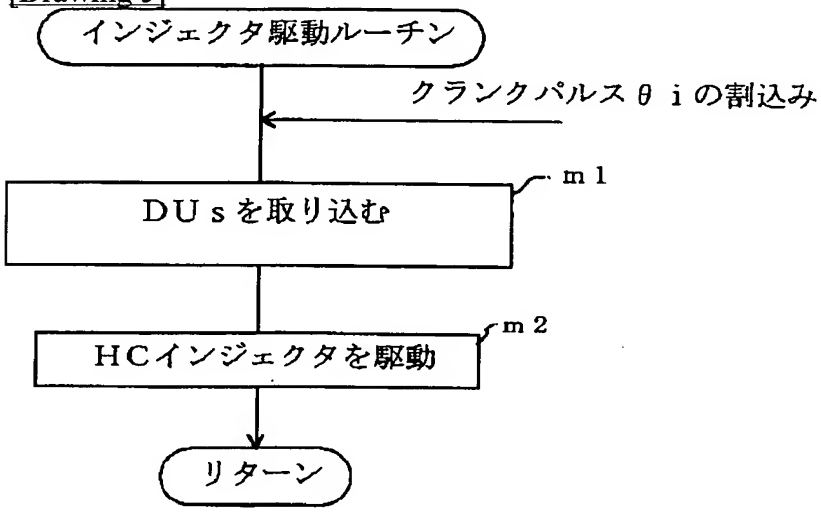
[Drawing 3]



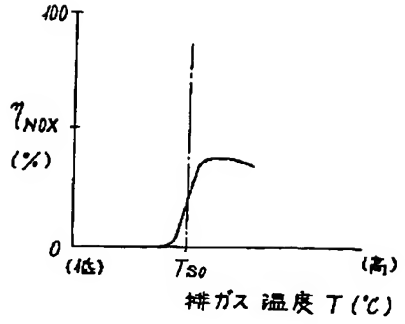
[Drawing 4]



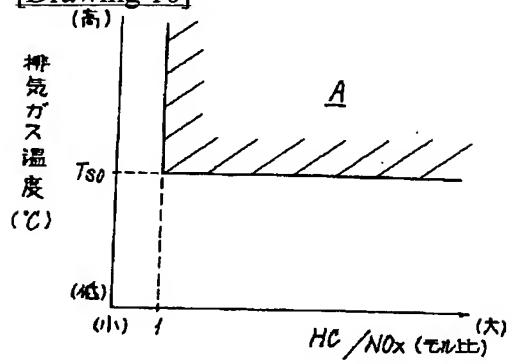
[Drawing 5]



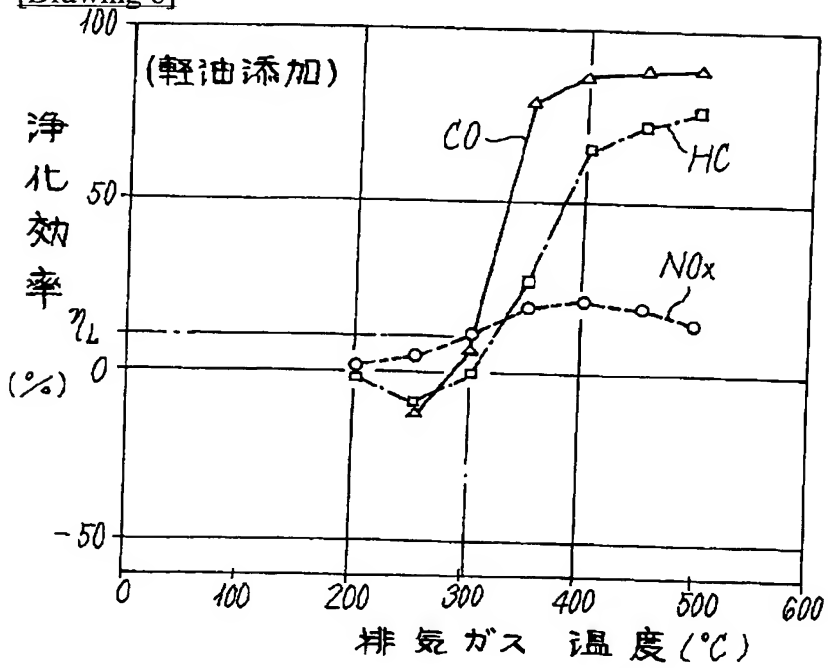
[Drawing 9]



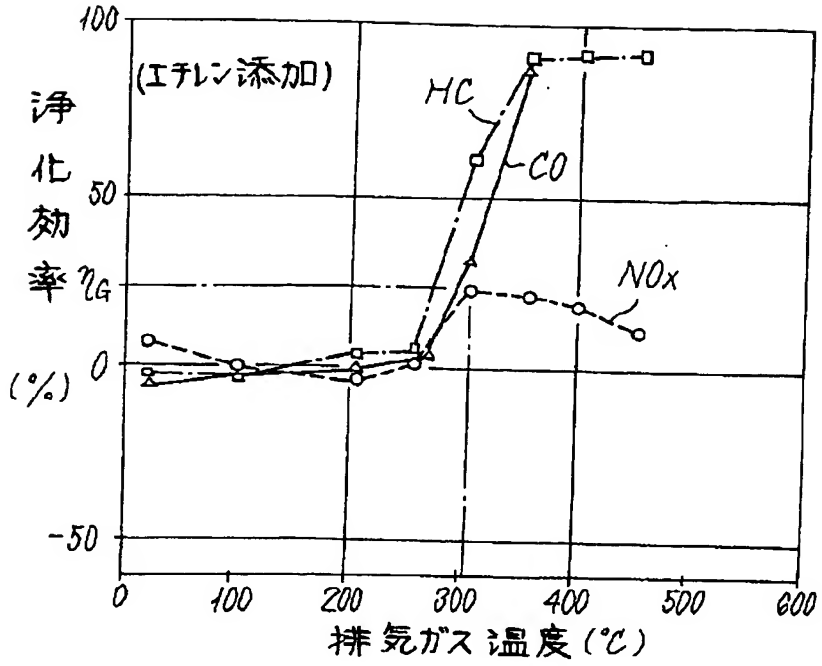
[Drawing 10]



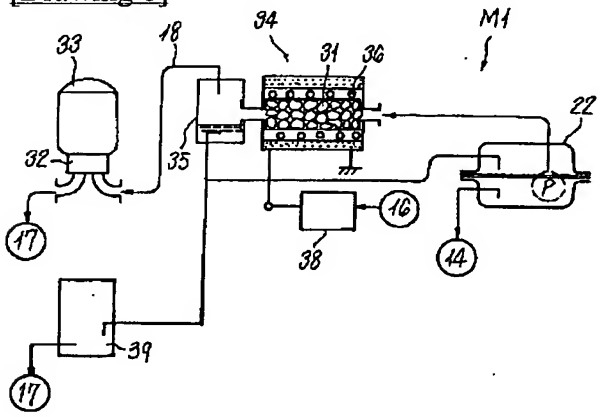
[Drawing 6]



[Drawing 7]



[Drawing 8]



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